Check for updates

Received: 11 July 2023 | Revised: 28 March 2024 | Accepted: 14 April 2024

DOI: 10.1002/ajp.23631

RESEARCH ARTICLE

AMERICAN JOURNAL OF PRIMATOLOGY WILEY

Ethnoprimatology reveals new extended distribution of critically endangered banded langur *Presbytis femoralis* (Martin, 1838) in Pahang, Malaysia: Insights from indigenous traditional knowledge and molecular analysis

Hidayah Haris[1] | Nursyuhada Othman[1] | Munian Kaviarasu[1,2] | Muhammad Faudzir Najmuddin[1] | Nurfatiha Akmal Fawwazah Abdullah-Fauzi[1] | Farah Farhana Ramli[1] | Nur Hartini Sariyati[1] | Mohd Lokman Ilham-Norhakim[1,3,4] | Badrul Munir Md-Zain[5] | Muhammad Abu Bakar Abdul-Latiff[1]

[1]Environmental Management and Conservation Research Unit (eNCORe), Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), Muar, Johor, Malaysia

[2]Zoology Branch, Forest Biodiversity Division, Forest Research Institute Malaysia (FRIM), Kepong, Selangor, Malaysia

[3]Kim Ichthyologist Centre, Kg Parit Samsu, Jalan Temenggong Ahmad, Parit Jawa, Muar, Johor, Malaysia

[4]Akim Fishes Enterprise, 81P Pesta 2, Kg Kenangan Tun Dr Ismail, Muar, Johor, Malaysia

[5]Department of Biological Sciences and Biotechnology, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

Correspondence

Muhammad Abu Bakar Abdul-Latiff, Environmental Management and Conservation Research Unit (eNCORe), Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (Pagoh Campus), 84600 Muar, Johor, Malaysia.
Email: latiff@uthm.edu.my

Funding information

Ministry of Higher Education Malaysia, Grant/Award Number: FRGS/1/2022/WAB11/UTHM/02/2-(UTHM-K416); Pusat Pengurusan Penyelidikan, Universiti Tun Hussein Onn Malaysia, Grant/Award Number: RE-GG-Q065

Abstract

The banded langur (Presbytis femoralis) is a critically endangered primate, which within Malaysia has not been known to extend significantly outside the state of Johor. Traditionally, distribution studies on this highly threatened primate have relied on conventional methods such as DNA identification, live counting, and camera trapping. However, ethnoprimatology offers an alternative approach to data collection, involving the active participation of indigenous and local communities possessing valuable knowledge and experience with local primate species. This study employed an integrated approach incorporating ethnoprimatology by utilizing pooled local expert opinion, local surveys, interviews, and fecal DNA analysis, resulting in a novel distribution range for the banded langur. The combination of expert opinions revealed this species' most optimistic distribution scenario across Johor and Pahang, inhabiting various ecosystems, including lowland forests, peat swamps, and human-modified landscapes. Further interviews and surveys conducted within the Orang Asli community in Tasik Chini and Tasek Bera have provided additional support for the revised distribution, documenting occurrences of banded langur utilization in indigenous practices, such as food consumption, cultural beliefs, medicinal applications, and craftsmanship. Phylogenetic analysis demonstrated genetic differentiation between populations in Johor and Pahang, with the populations in the southern part of Peninsular Malaysia likely serving as ancestral sources for other populations. Consequently, this study not only elucidated the updated distribution of banded langur through DNA records and direct observations but also established the efficacy of ethnoprimatology as a precursory tool for uncovering the present distribution patterns of other primate species in Malaysia.

Abbreviations: PERHILITAN, Department of Wildlife and National Parks Peninsular Malaysia; PLEO, pooled local expert opinion.

[Correction added on 31 August 2024, after first online publication: Minor clarifications regarding the geographical distribution of *Presbytis femoralis* have been made in the Abstract, Introduction, Methods, and Discussion. Md-Zain, B.M. (2004) has been added to the reference list in order to note the discovery of this species in border of Johor-Pahang. The original grant number was incorrectly listed in the original version and has been replaced with the correct grant number.]

 © 2024 Wiley Periodicals LLC.

KEYWORDS
colobinae, ethnozoology, indigenous people, man and biosphere reserve, ramsar site, wildlife

1 | INTRODUCTION

The interdisciplinary field of ethnoprimatology has emerged as a valuable approach to exploring the intersection between human culture and primate populations (Fuentes, 2012). The term 'ethnoprimatology' generally refers to the study of interactions between human and nonhuman primate populations in areas where these species coexist (Sponsel, 1997). Previous research has employed conventional approaches, such as direct observation, interviews, surveys (Green & Gabriel, 2020; Mekonnen et al., 2020), as well as modern tools like camera trapping, Geographical Information System (GIS), and genetic studies to update the taxonomy, population, distribution, and biogeography of Malaysian primates (Bersacola et al., 2022; Md-Zain et al., 2010; Shanee et al., 2023). Ethnoprimatology provides an alternative method for collecting primate data, as it involves the participation of indigenous and local people who possess valuable knowledge and experience with local primates (Fuentes et al., 2016; Howells et al., 2022). This approach facilitates the analysis of anthropogenic activities, such as hunting, trapping, and trade, as well as the effects of cultural practices related to the use of primates for food, medicine, and religious purposes (Fuentes & Hockings, 2010; Fuentes, 2012; Lee, 2010; Malone et al., 2014; Zahari et al., 2021). By enhancing the understanding of the social, cultural, and ecological contexts of primate-human interactions, these techniques assist in developing strategies for primate population management and conservation (Hsu et al., 2009; Mekonnen et al., 2020; Parathian & Maldonado, 2010). Consequently, the integrated approach of ethnoprimatology is gradually gaining recognition as a widely used methodology for studying primatology, offering new perspectives that are sometimes overlooked in traditional studies (Fuentes, 2006; Riley, 2007).

In Peninsular Malaysia, the aborigines, locally called Orang Asli (OA), are classified into three groups: Negrito, Senoi, and Proto-Malay, encompassing a total of 18 ethnic groups (Fix, 2000; Jabatan Kemajuan Orang Asli [JAKOA], 2020). Ethnoprimatological studies have proven helpful in understanding primate behavior and conservation issues related to the OA communities. For example, Najmuddin, Afiqah, et al. (2021), Najmuddin, Haris, et al. (2021) and Zahari et al. (2021) have reported the coexistence of *Presbytis* species with OA, sharing the same ecological and social environment. Moreover, some of these endangered species, particularly in Tasik Kenyir, Terengganu, have become primary targets for hunting by the Semoq Beri ethnic community, who rely on hunting sessions for sustenance (Bartholomew et al., 2021; Lye, 2021). However, the use of different local names by various OA ethnic groups complicates the identification of langur species in their respective regions (Abdul-Latiff et al., 2021; Najmuddin, Afiqah, et al., 2021). As conservation efforts continue to evolve, there is a growing recognition of the importance of integrated approaches that consider ecological and cultural factors in studying primate species (Fuentes, 2006; Riley, 2007). Therefore, ethnoprimatology serves as a tool for examining the subtle interactions between people and primates in Peninsular Malaysia, offering fresh perspectives, especially on shy and elusive species like *Presbytis femoralis*, particularly regarding their distribution and importance.

Within Malaysia, approximately nine identified species of colobines have been proposed, including the banded langur (*P. femoralis*) (Groves, 2001; Md-Zain, 2001). Locally known as "lutong cenekah," the banded langur can be easily distinguished by its distinct morphology, characterized by a small-sized body with black fur, a white zone on the abdominal part and inside the thighs, and the presence of a unique white mascara patch around the eyes (Groves, 2001; Oates & Davies, 1994). Traditionally classified into three subspecies, recent treatments have elevated them to the species level, now recognized as *P. femoralis*, *P. robinsoni*, and *P. percura*, as acknowledged here (Abdul-Latiff, Baharuddin, et al., 2019; Aimi & Bakar, 1996; Groves, 2001; Md-Zain et al., 2010). The estimated population size of *P. femoralis* in Malaysia and Singapore is fewer than 500 mature individuals (Abdul-Latiffa, Baharuddin, et al., 2019; Ang et al., 2020; Najmuddin, Haris, Othman, et al., 2020; Najmuddin, Haris, Norazlimi, et al., 2020), leading to its classification as Critically Endangered on the IUCN Red List. This critical status is primarily attributed to forest clearance and land conversion, particularly for oil palm plantations (Abdul-Latiffa, Baharuddin, et al., 2019; Haris, 2021; Md-Zain et al., 2019; Najmuddin, Haris, Norazlimi, et al., 2019; Najmuddin, Haris, Shahrool-Anuar, et al., 2019).

Currently, the fragmented distribution of *P. femoralis* can be found in tropical rainforests in Johor, such as Gunung Panti, Gunung Lambak, and Mersing, as well as areas heavily covered by oil palm plantations in Kota Tinggi (Haris, 2021; Md-Zain, 2001; Najmuddin, Haris, Othman, et al., 2020; Najmuddin, Haris, Norazlimi, et al., 2020). While there have been claims of their presence in the southern part of Pahang bordering the state of Johor, (Md-Zain 2004) no scientific evidence has been reported thus far (Abdul-Latiff, Baharuddin, et al., 2019; Brandon-Jones et al., 2004; Roos et al., 2014). The most recent comprehensive assessment on *P. femoralis* in Malaysia was conducted by Abdul-Latiff, Baharuddin, et al. (2019) with a primary focus on resolving the taxonomic discrepancy of *P. femoralis* and ultimately elevating its classification to the species level based on phylogenetic analysis. Molecular data is also an alternative instrumental in gaining better insights into primate evolution and improving the systematic classification of Malaysian primates (Abdul-Latiff, Baharuddin, et al., 2019; Md-Zain et al., 2010). However, despite these advancements, this species' exact distribution and population numbers remain unresolved. Therefore, there is a pressing need to explore the undiscovered *P. femoralis* populations in the country to clarify their phylogenetic relationships and contribute to developing a more effective conservation plan.

Moreover, minimal attention has been given to this species group to date, primarily due to the challenges associated with studying a less habituated species that is inherently shy and elusive (Abdul-Latiff, Baharuddin, et al., 2019; Md-Zain & Ch'ng, 2011). While there

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

are only a few published studies on the distribution of *P. femoralis* in Malaysia, which only cover the southern part of Peninsular Malaysia in Johor, the hypothesis suggests the presence of this species in the central Peninsular Malaysia specifically Pahang (Abdul-Latiff, Baharuddin, et al., 2019). Consequently, this study aims to (1) update the distribution of *P. femoralis* in Peninsular Malaysia using an ethnoprimatological approach as a precursor, together with molecular evidence, and (2) illustrate the potential distribution of *P. femoralis* based on existing ranging areas.

2 | METHODS

2.1 | Ethical statement

This study was carried out in adherence with the guidelines put forth by the American Society of Primatologists' Principles for the Ethical Treatment of Non-Human Primates. All procedures were reviewed and permitted by the Department of Wildlife and National Parks Malaysia (permit number: JPHL& TN(IP):100-34/1.24 Jld 8), adhered to Universiti Tun Hussein Onn Malaysia's Animal Ethics and approved by Institutional Biosafety Committee (IBC) (IBC (N) 100-18/6/001). All fecal samples were obtained noninvasively, while maintaining a safe distance from the study species. This study also secured permission from the Department of Orang Asli Development (JAKOA) (permit number: JAKOA.PP.R.003 JLD 7 (37)) to conduct ethnoprimatological surveys and interviews, as well as permission from the Pahang State Biodiversity Council (reference number: MBP.600(S)−1/1/1 Jld.6 (22)).

2.2 | Study site

The surveys for the presence of *P. femoralis* covered several forest areas in western, eastern, and middle state of Johor, as well as southern part of Pahang, between 2018 and 2023 (Figure 1). The selection of study sites included several localities drawn from existing published reports (Abdul-Latiff, Baharuddin, et al., 2019; Abdul-Latiff, Najmuddin, et al., 2019; Najmuddin, Haris, Norazlimi, et al., 2019; Najmuddin, Haris, Shahrool-Anuar, et al., 2019; Najmuddin, Haris, Othman, et al., 2020; Najmuddin, Haris, Norazlimi, et al., 2020; Najmuddin, Haris, et al., 2021), including opportunistic records from rapid assessment surveys, other fieldworks, and expeditions.

2.3 | Pooled local expert opinion (PLEO) method

This study used two complementary methods: primate surveys and interviews with local people. Before the primate survey, the data collection method relied in part on the knowledge of local people about wildlife (Mayaka et al., 2015; van de Hoeven et al., 2004). The information on the presence of the species and its ranging area was gathered from expert local people and used to select survey sites using the Pooled Local Expert Opinion (PLEO) method (Najmuddin, Haris, Sufahani, et al., 2023). Several local people, such as the headman, boatmen, farmer, and herders, were interviewed to gather their knowledge, especially on the hot spots to find the banded langur. The selection of local people followed a snowball sampling approach, targeting individuals who: (1) reside in areas neighboring the forest reserve, (2) frequently enter the forest area, and (3) have fundamental knowledge of primates through personal observations. Prior consent was obtained from the local people before conducting interviews and taking photos. From this information, the most potential sites and most probable time for primate sightings were drawn out, and local villagers assisted in plotting the location on a topographic map or Google Map.

Another approach for additional information on the presence of *P. femoralis* involved the Department of Wildlife and National Park (PERHILITAN), which is responsible for wildlife affairs. PERHILITAN has 20 branches in Pahang, 13 branches and stations in Johor and three branches in Melaka. Since Pahang and Melaka are connected to Johor, the original extant of *P. femoralis*, these locations were selected for assessing the possible extended distribution and population of the species. This method was adapted from the previous study by Meijaard et al. (2011) on Orangutan hunting assessment in Kalimantan, Indonesia. The survey questions focused on demographics and five main elements regarding *P. femoralis*, including knowledge about the species, conflict related to its presence, presence in each district, estimation of population size and the most recent sighting. An online survey through Google form was also implemented to obtain a broader assessment of the distribution and population of *P. femoralis*. The online survey was distributed internally through the organization's email. Each PERHILITAN branch needed to complete surveys tailored to their respective states. Subsequently, all data was extracted and analyzed.

2.4 | Ethnoprimatological survey and interview

A mixed-methods approach involving surveys and semi-structured interviews was employed to investigate the knowledge and attitudes of the Orang Asli community towards *P. femoralis*. The survey was conducted in selected Orang Asli villages where the species can be found, specifically around Endau-Rompin and Tasik Chini for the Jakun subtribe and Tasek Bera for the Semelai subtribe, involving individuals from various age groups. Access and Benefit Sharing (ABS) and Prior Informed Consent were obtained from all participants before conducting the surveys and interviews, ensuring not only their participation but also informing them comprehensively about the research, thus ensuring their benefit from involvement in the study. The session involved a total of 80 respondents, with 35, 40, and 5 respondents from Endau-Rompin (Jakun subtribe), Tasik Chini (Jakun subtribe), and Tasek Bera (Semelai subtribe), respectively. It is worth noting that the survey conducted in Tasek Bera was a preliminary study with a smaller sample size compared to the other two locations.

The questionnaire consisted of two parts. The first part aimed to gather demographic information from the respondents, including age, gender, and occupation, while the second part focused on

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

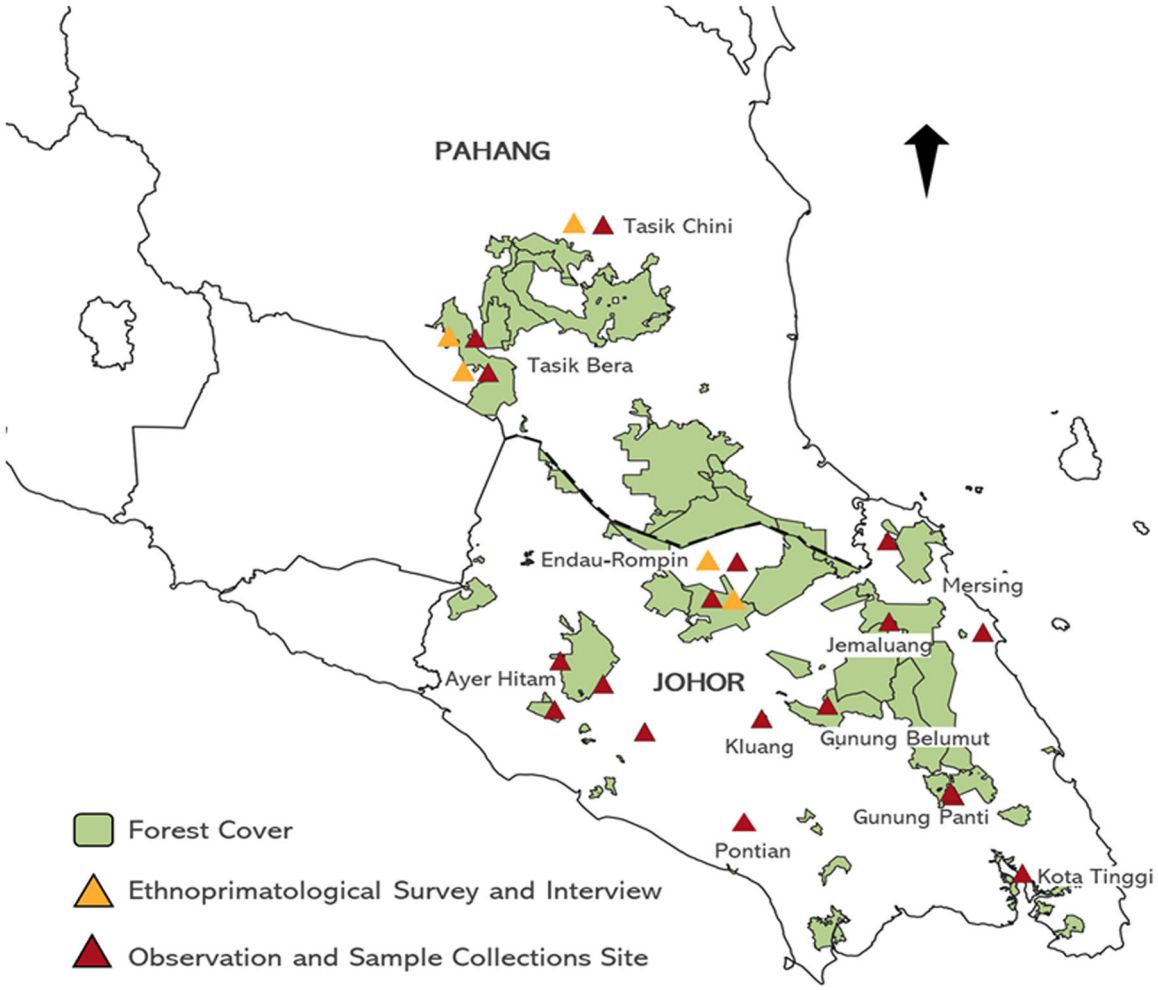

FIGURE 1 Map of the study sites in the state of Johor and Pahang.

ethnozoological knowledge and wildlife consumption, aiming to explore the respondents' attitudes and perceptions toward *P. femoralis* in the area. Specifically, the respondents were asked about the wildlife's local names, uses, and methods of use. To enhance clarity and accuracy, visual aids, such as pictures of the animals, their common local name, and scientific names, were provided to assist the respondents in answering the survey questions. The questionnaire was written in Malay to facilitate better comprehension by the respondents. All interview information was recorded in a jotter book and captured using audio and video recorders for thematic analysis. Eventually, the information on possible locations for primate sighting was collected and updated for intensive observation.

2.5 | Intensive primate observation and fecal samples collection

The GPS coordinates of potential primate sites gained from the surveys were used to navigate to the primate sighting site. Scan sampling was used to document the presence of *P. femoralis*, mainly by trekking and driving along the available roads at the forest edge and by boat survey. Attention was given to the upper parts of trees and direct signs, such as loud vocalizations for alarm calls and crashing sounds of branches, indicating the presence of primates in the area. When the banded langur was discovered, information such as the time, precise GPS coordinates, group composition, environmental conditions including habitat types (primary forest, secondary forest, rubber plantation, palm oil plantation, and shrubs) and supplementary behavior notes were recorded. Photographic evidence was collected with binoculars, Canon DSLR 7D, and Canon 70–300 mm F4-5.6 L lens, which were essential for species confirmation and helped ensure that no misidentification of the primate species happened. Morphological characteristics distinctive of banded langur, such as black fur, narrow gray band surrounding the eyes, and peculiar 'ka-ka-ka-ka' sound produced by banded langur, were observed. Two teams were deployed in every study site; each group was well equipped with observation tools and vehicles to roam throughout the study area to increase efficiency.

Concurrently with visual observations, fecal samples of *P. femoralis* were opportunistically collected from each of the 11 study sites along with fecal samples of *Presbytis siamensis* and *Presbytis robinsoni* serving as a representative of the sister taxa in Peninsular Malaysia. Banded langurs often leave prominent

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

accumulations of feces along trails, especially during feeding hours. The fecal samples were collected using disposable plastic spoons once the langurs moved to other trees. Fecal sample collection was conducted following the protocol of the noninvasive method proposed by Abdul-Latiff et al. (2017). A minimum fecal sample size of a tablespoon was collected, and the fresh samples were secured from foreign materials such as rocks or soil. Then, the fecal samples were stored in a 50 mL labeled vial containing absolute ethanol (99%). The samples were kept in −20°C freezer in a laboratory to preserve the DNA traces in the feces before further procedures. Based on Md-Zain and Ch'ng (2011), leaf monkeys will have greenish-colored feces as they are folivorous herbivores.

2.6 | DNA extraction, sequencing and phylogenetic analysis

A total of 26 fecal samples of *P. femoralis* were collected from several localities in Johor (Kota Tinggi, Mersing, Kluang, Pontian, Jemaluang, Gunung Belumut and Gunung Panti) and Pahang (Tasek Bera and Tasik Chini) (Table 1). Before DNA extraction, fecal samples were weighed using an analytical balance. DNA was then extracted from 0.5 to 1.0 g of fecal samples (Abdul-Latiff et al., 2014; Aifat et al., 2016) using the InnuPREP Stool DNA Kit (Analytic Jena, Germany) following the manufacturer's protocol. By using an Alpha Cycler PCRmax, a total of ~ 500 bp fragments of the mtDNA D-*loop* were successfully amplified through a polymerase chain reaction (PCR) using the primers described by Meyer et al. (2011) (Table 2). The profile for the PCR reaction were as follows: initial denaturation for 2 min at 95°C, followed by 40 cycles of denaturation for 1 min at 94°C, annealing for 1 min at 58°C, extension for 1 min at 72°C, and a final extension stage for 5 min at 72°C. Then, the PCR products were sequenced for further bioinformatic analysis.

The obtained raw sequences were edited using Bioedit Sequence Alignment Editor and subsequently blasted through GenBank BLASTn for sequence similarity search analysis. The MEGAX ClustalW multiple alignment algorithm (Kumar et al., 2018) was used to align all 26 sequences with one sequence from *P. siamensis*, *P. robinsoni*, *P. thomasi*, *P. frontata* and *P. hosei*. The sequence of *Trachypithecus obscurus* was retrieved from GenBank as the outgroup. The phylogenetic analysis was conducted based on three approaches, including neighbor-joining (NJ), maximum parsimony (MP), and Bayesian inference (BI), to analyze the taxonomic positions of the *P. femoralis* populations. Bayesian tree was constructed using Mr Bayes 3.1 (Ronquist et al., 2005). The Bayesian tree was constructed using a metropolis-coupled Markov chain Monte Carlo (MCMC) model that was run for 10 million generations and sampled every 1000 generations until the mean deviation of split frequency lies below 0.01. The initial 25% of the trees were discarded as burn-in. Finally, the number of haplotypes, haplotype diversity, and segregation site in the population were determined using DnaSP v4.0 (Rozas et al., 2003), and the relationships between haplotypes

TABLE 1 List of fecal samples collected in Johor and Pahang.

List of Samples	Species	Locality
IHPFC54	*Presbytis femoralis*	Tasek Bera
IHPFC55	*Presbytis femoralis*	Tasek Bera
HHPFC90	*Presbytis femoralis*	Tasik Chini
HHPFC91	*Presbytis femoralis*	Tasik Chini
HHPFC94	*Presbytis femoralis*	Tasik Chini
HHPFC96	*Presbytis femoralis*	Tasik Chini
HHPFJ136	*Presbytis femoralis*	Gunung Panti
HHPFJ137	*Presbytis femoralis*	Gunung Panti
IHPFJ138	*Presbytis femoralis*	Jemaluang
HHPFJ96	*Presbytis femoralis*	Gunung Belumut
HHPFJ97	*Presbytis femoralis*	Gunung Belumut
HHPFJ98	*Presbytis femoralis*	Gunung Belumut
HHPFJ139	*Presbytis femoralis*	Gunung Belumut
HHPFJ140	*Presbytis femoralis*	Kluang
HHPFJ141	*Presbytis femoralis*	Kluang
HHPFJ142	*Presbytis femoralis*	Kluang
HHPFJ143	*Presbytis femoralis*	Kluang
HHPFJ144	*Presbytis femoralis*	Mersing
HHPFJ145	*Presbytis femoralis*	Mersing
HHPFJ146	*Presbytis femoralis*	Mersing
HHPFJ147	*Presbytis femoralis*	Mersing
HHPFJ148	*Presbytis femoralis*	Kota Tinggi
HHPFJ149	*Presbytis femoralis*	Kota Tinggi
HHPFJ150	*Presbytis femoralis*	Kota Tinggi
HHPFJ151	*Presbytis femoralis*	Kota Tinggi
HHPFJ152	*Presbytis femoralis*	Pontian
HHPST23	*Presbytis siamensis*	Terengganu
HHPRA20	*Presbytis robisoni*	Perak
JF295113.1	*Presbytis frontata*	GenBank
JF295124.1	*Presbytis thomasi*	GenBank
JF295114.1	*Presbytis hosei*	GenBank
AY863425.1	*Trachypithecus obscurus*	GenBank

TABLE 2 Primer pairs used for amplification of D-loop region (Meyer et al., 2011).

Gene	Primer
D-loop	ACG ATC TGG GCA CTA GGT AG (Forward)
	TGA TAG ACC CGT GAT CCA TC (Reverse)

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

were depicted using Network 4.6.1.2's minimum-spanning network (MSN).

2.7 | Population genetics and molecular divergence of *Presbytis femoralis*

The genetic diversity was assessed across seven populations with a minimum two sequences for each locality based on the available fecal samples collected from study sites. Two summary statistics, nucleotide diversity (π) and haplotype diversity (*Hd*), were calculated using DnaSP 5.10 (Rozas et al., 2017). Analysis on migrant per generation was carried out by comparing each locality using DnaSP software to infer any occurrence of gene flow between the examined populations. A median-joining haplotype network was built using NETWORK 10.0 software (Bandelt et al., 1999; available at http://www.fluxus-engineering.com).

To estimate the divergence time of *P. femoralis*, BEAUti 1.10.4 and BEAST 1.10.4 (Suchard et al., 2018) were assessed by dividing the current data into three sets: *T. obscurus* as a calibration point, *P. femoralis* (Pahang and Johor) and *Presbytis* group. The phylogenetic tree was reconstructed using the uncorrelated lognormal relaxed clock mode and Yule model before estimate the substitution rate for all the nodes in the tree with uniform distribution. Published calibration point were used for *T. obscurus* (Meyer et al., 2011) and prior in normal distribution with a mean of 11.47 Ma and standard deviation of 2.5 Ma. The Bayesian MCMC was run for 10 million generations, with 10% burn-in of initial tree at every 1000 generations. Values of ESS for all parameters for instance posterior, likelihood, ucld. mean were viewed in Tracer version 1.7.5 and the construction of tree was proceeded once the values were satisfactory (Abdul-Latiff, Baharuddin, et al., 2019; Meyer et al., 2011). The maximum-clade-credibility tree topologies were calculated using posterior distribution, and Tree Annotator version 1.10.4 was employed to summarize the tree (Rambaut & Drummond, 2005). Finally, the final phylogenetic tree was viewed using FigTree version 1.4.4 (Rambaut, 2006).

2.8 | Mapping new distribution and potential distribution

Geographic data for *P. femoralis* from the field surveys and opportunistic sightings during other fieldwork were compiled. All the coordinates were reviewed before mapping them using QGIS 3.16 software (QGIS Development Team, 2022) and transformed into a map for display. To validate localities, we used Google Earth imagery to double-check coordinates and georeferencing to account for the species' known range area. A total of 14 sighting record locations were obtained and utilized for the mapping. As for the potential migration pathway, mapping was based on estimated gene flow and shared haplotypes between examined populations. The potential distribution of targeted populations was estimated based on variables such as home range size (~20 km), habitat use in relation to substrate, vegetation coverage, forest connectivity and forest linkages.

3 | RESULTS

3.1 | Pooled local expert opinion (PLEO)

The first map in Figure 2 presents the potential distribution of *P. femoralis*, as indicated solely by the results from survey data, which encompasses all districts in Johor, Melaka, and Pahang. According to the survey, the districts with the highest probability of presence (0.31-0.40) include Kota Tinggi, Kluang, Mersing, and Segamat in Johor, while in Pahang, Jerantut and Temerloh exhibit high presence probabilities. Other districts in southern Johor, Melaka, and the rest of Pahang show a presence probability range between 0.11 and 0.30. It is worth noting that as the number increases, approaching 1 (colored in red) reflects a higher probability of detecting this species in the area. In the second map of Figure 2, as of the present date, the distribution extent available on the IUCN Red List of threatened species map only covers half of southern Johor and Singapore.

3.2 | Orang asli knowledge and attitudes towards *Presbytis femoralis*

The knowledge among Orang Asli was incorporated in defining the extent of the species occurrence through extensive interviews and surveys with the community members. In Endau-Rompin (Jakun subtribe), data were collected from 35 respondents out of 306 residents residing in Kampung Peta. While in Tasik Chini (Jakun subtribe), a total of 40 respondents out of an estimated population of 550 were surveyed across various villages with the highest number of respondents coming from Kampung Gumum (19), followed by Ulu Gumum (9), Kampung Melai (6), Kampung Tanjung Puput (3), Kampung Cendahan (2), and Kampung Tanjung Sambet (1). Additionally, 5 out of an estimated population of 530 respondents were interviewed from Tasek Bera (Semelai subtribe), with two people from Kampung Limbahan and Kampung Gau as well as one from Kampung Jelawat in Pos Iskandar. The demographic details of all the 80 participants are presented in Table 3.

The survey indicated that 13 respondents from Endau-Rompin, eight out of 40 from Tasik Chini, and all five from Tasek Bera claimed they had observed this species in their respective livelihood areas. Apart from that, additional information on the utilization of *P. femoralis* in their life varied among the different Orang Asli tribes and locations (Table 4). Note that each tribe has its own local name for the primate species. The Jakun subtribe in Endau-Rompin and Tasik Chini referred to *P. femoralis* as "baseng" and "cenekah," they mainly utilizing this species for consumption purposes in both areas. In addition, Jakun subtribe in Tasik Chini also has their own spiritual beliefs related to this species. According to them, after successfully hunting the banded langur, they are discouraged from processing the primate in the village area. Instead, they can only bring

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

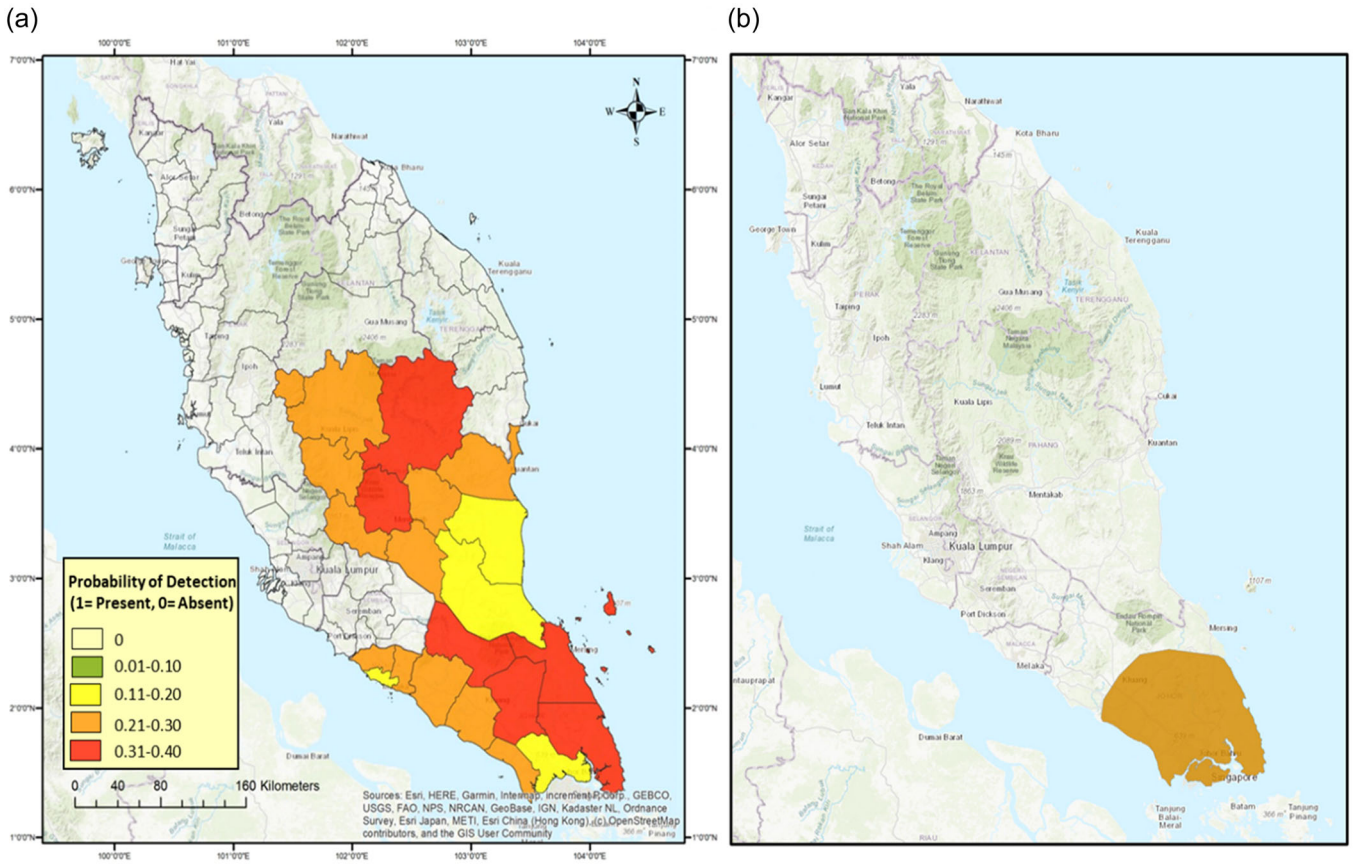
(a)
(b)
Probability of Detection
(1= Present, 0= Absent)
0
0.01-0.10
0.11-0.20
0.21-0.30
0.31-0.40
0 40 80 160 Kilometers
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Kuala Lumpur
Singapore

FIGURE 2 Map of potential presence of the species based on PLEO surveys. (a) Potential presence of *Presbytis femoralis* based on surveys. (b) Distribution of *Presbytis femoralis* based on IUCN.

TABLE 3 Demographic data of respondent in selected sites.

Demographic profile Tribe	Endau-Rompin Jakun subtribe	Tasik Chini Jakun subtribe	Tasek Bera Semelai subtribe
Gender			
Male	22 (62.9%)	23 (57.5%)	3 (60.0%)
Female	13 (37.1%)	17 (42.5%)	2 (40.0%)
Age			
15-20	3 (8.6%)	3 (7.5%)	0 (0.0%)
21-30	8 (22.9%)	10 (25.0%)	0 (0.0%)
>31	24 (68.5%)	27 (67.5%)	5 (100.0%)
Working			
Yes	29 (82.9%)	34 (85.0%)	4 (80.0%)
No	6 (17.1%)	6 (15.0%)	1 (20.0%)

back the meat, as processing it locally would emit a very strong and unpleasant odor. Moreover, it is believed that such an action may bring bad luck to certain families that are prohibited from consuming some primate species.

TABLE 4 Orang Asli knowledge and usage of *Presbytis femoralis* in their culture and tradition.

Location	Subtribe	Local name	Usage
Endau-Rompin	Jakun	*Baseng, Cenekah*	a
Tasik Chini	Jakun	*Baseng, Cenekah*	a, d
Tasek Bera	Semelai	*Baseng, Kekeh*	a, c, e

Note: a, food; b, pet; c, medicine; d, belief; e, crafts and arts.

Conversely, the interview with the Semelai subtribe in Tasek Bera documented various uses of *P. femoralis*. These include consumption for sustenance, medicinal purposes, crafting, and artistic endeavors. The Semelai subtribe also believes that consuming this species provides additional energy. They utilize the skin of *P. femoralis* to create a traditional drum-like musical instrument called "gendang," which is prominently used during festivals (Figure 3). The skillful utilization of *P. femoralis* skin not only showcases their resourcefulness but also contributes to vibrant cultural expression, and it is done in a manner that does not jeopardize the species' population. However, it is worth mentioning that a small proportion of respondents from all three locations reported only sightings of *P. femoralis* without engaging in any utilization or exploitation of the species.

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

The results indicate that *P. femoralis* is primarily consumed as a food source in all three locations (Figure 4), with the highest frequency of consumption reported in Tasik Chini (17, 94%) and the lowest in Tasek Bera (4, 66%). Additionally, belief in the supernatural attributes of *P. femoralis* is only reported in Tasik Chini (1, 6%). In contrast, its usage in medicinal practices, crafts, and arts is only reported in Tasek Bera (1 each). There were no documented instances of keeping *P. femoralis* as a pet in any of these locations. Nevertheless, our findings suggest that the frequency of *P. femoralis* consumption by the Orang Asli community is decreasing. This decline can be attributed to the species' reduced abundance in its natural habitat, which aligns with the respondents' perception that locating the species has become more challenging.

3.3 | Phylogenetic analysis of *Presbytis femoralis*

The phylogenetic trees for NJ, MP, BI and molecular clock phylogenetic trees show consistent tree topological formations, which were summarized in a single phylogenetic tree (Figure 5).

FIGURE 3 A traditional drum-like musical instrument called “gendang” made from the skin of *Presbytis femoralis* used during festivals.

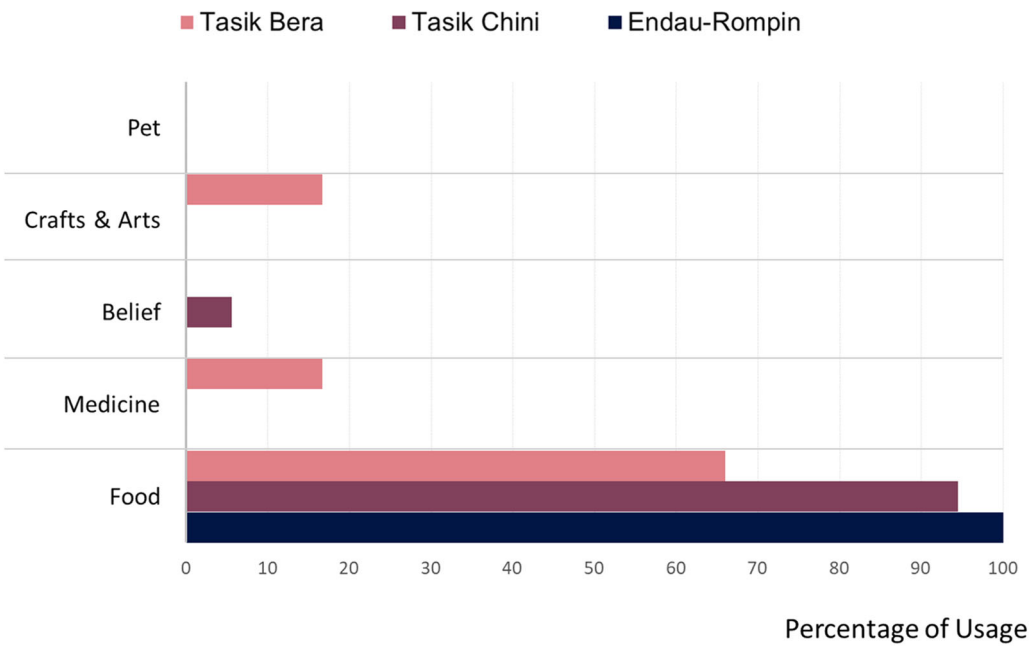

FIGURE 4 Percentage of usage of *Presbytis femoralis* among Orang Asli in three locations.

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

The *P. femoralis* was clearly separated between the Johor and Pahang populations. It was supported with 97% (NJ), 95% (MP) and 1.0 posterior probability (BI). As from the molecular clock established for *P. femoralis*, the trees similar to Abdul-Latiff et al. (2019c) with divergence time at 12.51 Ma were able to be reconstructed.

3.4 | Population genetics and molecular divergence

Migration of *P. femoralis* populations is evident, as gene flow has been detected among all examined populations, as shown in Table 5. Notably, significant gene flow was observed from the Mersing and Kota Tinggi populations to the other six examined populations, including Tasik Chini and Tasek Bera, with values of 0.05 and 0.15 migrants per generation, respectively. The second highest value of migrants per generation was recorded between Gunung Belumut and Mersing populations, with a value of 0.54. However, no gene flow was detected among the Gunung Belumut, Kluang, Gunung Panti, Tasik Chini, and Tasek Bera populations.

A total of 12 unique haplotypes were successfully identified from the seven examined populations of *P. femoralis*. The haplotype diversity, calculated with a value of $Hd = 0.926$, and the nucleotide diversity, with a value of $\pi = 0.03183$, were based on 26 sequences of the targeted species. Among the 12 haplotypes, only haplotype 9 was shared between Kota Tinggi and Mersing, while the rest of the haplotypes were unique to their respective localities. Using these

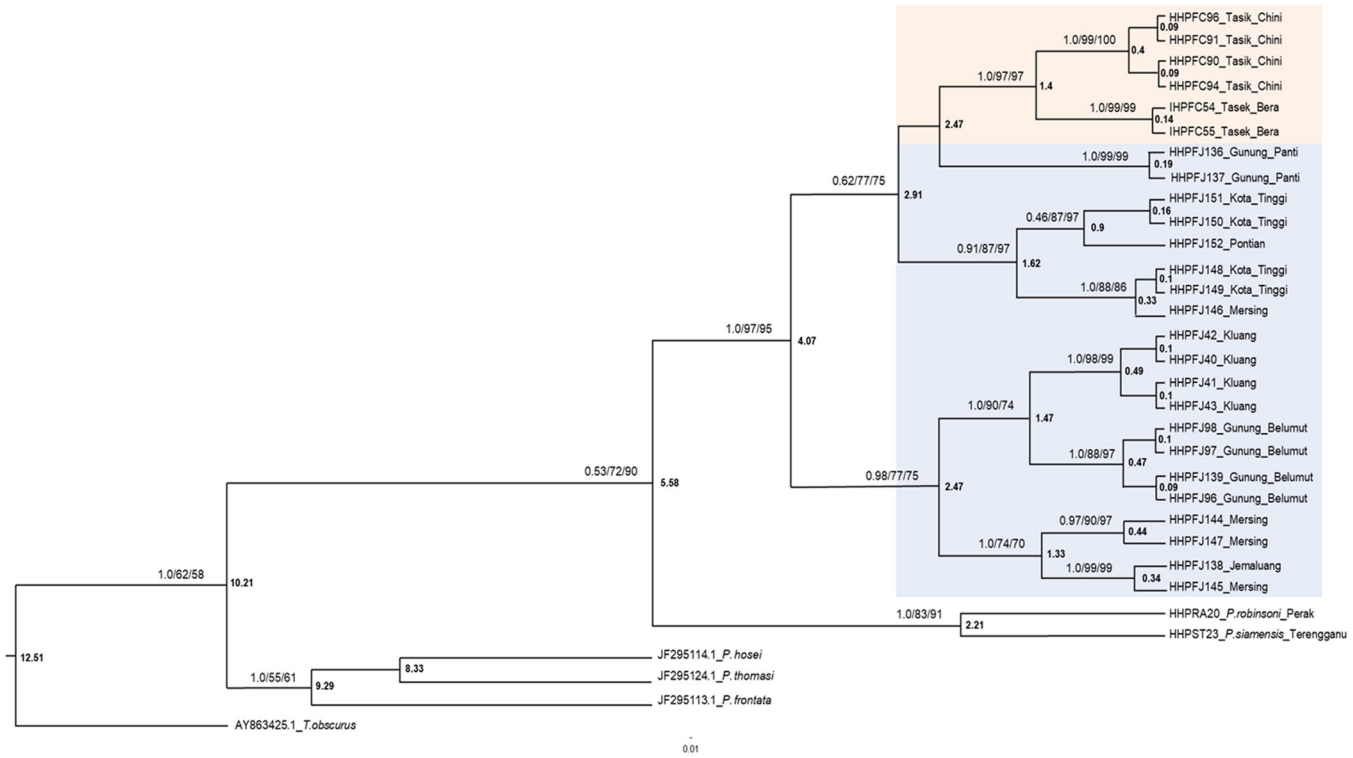

FIGURE 5 Summary of neighbor-joining (NJ), maximum parsimony (MP), Bayesian inference (BI), and molecular clock phylogenetic tree of *Presbytis femoralis*. Values above the branch represent posterior probability for BI/bootstrap values for NJ/bootstrap values for MP. Values on nodes represent divergence times of the clade.

TABLE 5 Measures gene flow (number of migrants, Nm) among seven populations of *Presbytis femoralis*.

	G. Belumut	G. Panti	Kluang	Kota Tinggi	Mersing	Tasek Bera	Tasik Chini
G. Belumut		0	0	0.10	0.54	0	0
G. Panti	0		0	0.12	0.34	0	0
Kluang	0	0		0.09	0.45	0	0
Kota Tinggi	0.10	0.12	0.09		0.76	0.05	0.05
Mersing	0.54	0.34	0.45	0.76		0.15	0.15
Tasek Bera	0	0	0	0.05	0.15		0
Tasik Chini	0	0	0	0.05	0.15	0	

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

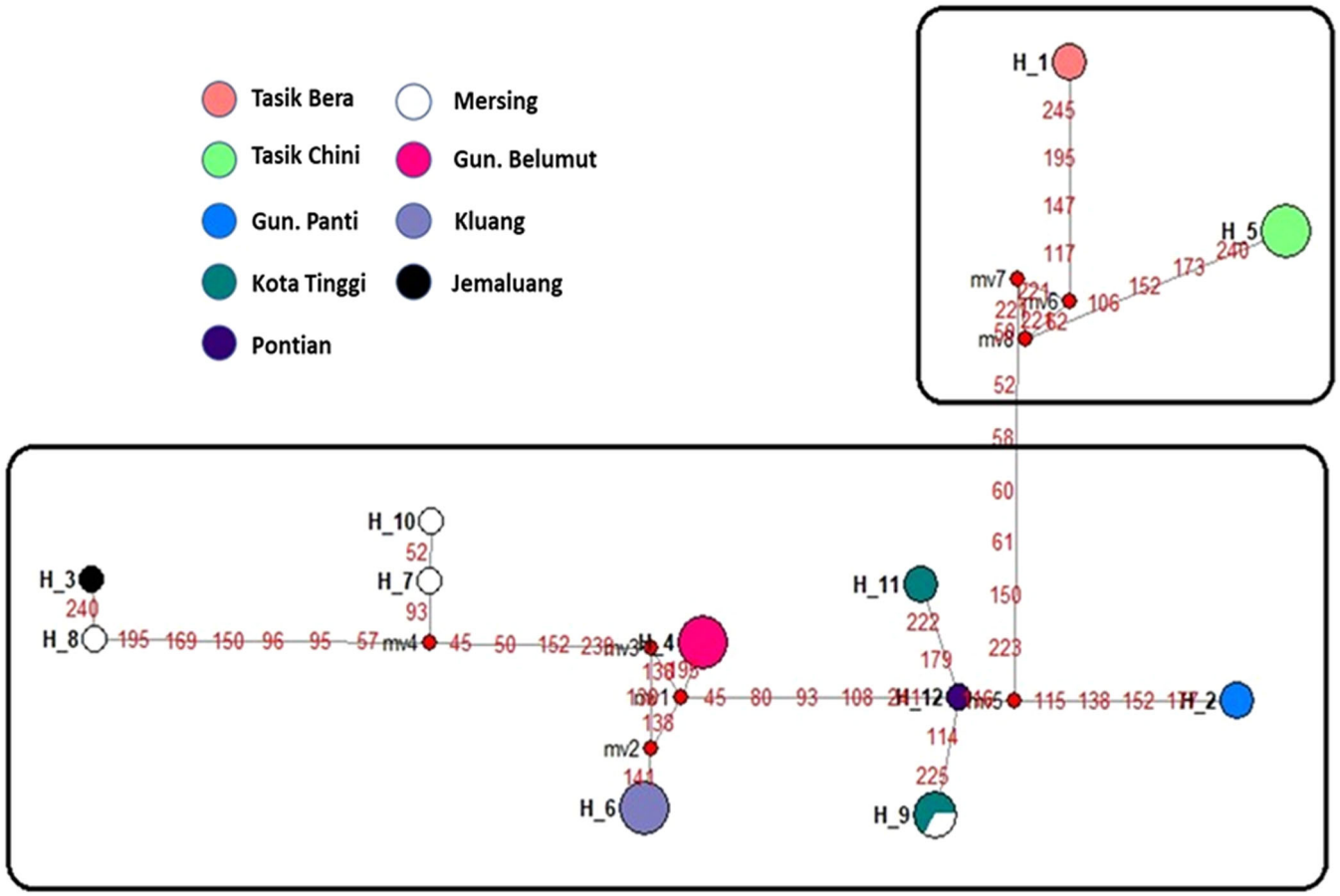

FIGURE 6 A minimum spanning haplotype network was constructed based on 12 haplotypes retrieved from examined populations of *Presbytis femoralis*.

12 haplotypes, a minimum spanning haplotype network was constructed, revealing that haplotype 1 (representing the Tasek Bera population) and haplotype 5 diverged significantly from the other examined populations, as illustrated in Figure 6.

4 | DISCUSSION

4.1 | Ethnoprimatological approach as new precursor

In this primate conservation study, the role of indigenous people and local communities in helping to protect and preserving primate populations should be given attention. The pooled opinion and data from the survey conducted on the extent of *P. femoralis* may indicate the best-case scenario for the undiscovered distribution of this species, but the data should be treated as pre-cursor and must be further confirmed through direct field observations or verifiable evidence. The spatial and ecological overlap between most Orang Asli communities in Peninsular Malaysia and primate species allows us to rely on their knowledge and integrate their information as crucial findings. The Orang Asli communities in Malaysia have a long history of living in close proximity to primates and relying on the forest for their livelihoods (Abdul-Latiff et al., 2021; Bartholomew et al., 2021). This has resulted in a wealth of knowledge of primate behavior, ecology, and distribution. As per the JAKOA (2020), approximately 206,777 Orang Asli live in Peninsular Malaysia, with 78,425 of them living in Pahang, including in Endau-Rompin, Tasik Chini and Tasek Bera. Orang Asli in Endau-Rompin and Tasik Chini comprise a majority of the Jakun subtribe while in Tasek Bera comprise of Semelai subtribe (both groups are sub-ethnic of Proto-Malay) (JAKOA, 2020). Most Orang Asli reside in rural areas and rely on nearby forest for traditional resource-harvesting activities like hunting and utilizing various species.

Similarly, studies on ethnozoology report that some *Presbytis* species are hunted by the Semoq Beri people in Pahang and Temuan people in Gunung Ledang as a food source (Abdul-Latiff et al., 2021; Najmuddin, Afiqah, et al., 2021; Zahari et al., 2021). Interestingly, our results align with these findings, as the majority of *P. femoralis* sightings reported by respondents in all three locations were near their settlements and the surrounding forest despite being hunted by the Orang Asli community. Moreover, our study revealed that besides its sustainably consumption as a food source, *P. femoralis* has been utilized by Orang Asli from two tribes in various ways, including traditional medicine, religious beliefs, and

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

crafts and arts. This represents the first documentation of such utilizations for this species, providing valuable insight into the relationship between the Orang Asli and *P. femoralis*. Nevertheless, local reports suggest that these primates tend to avoid humans, likely due to their shy and passive personalities. The results of this study suggest that integrating ethnoprimatology approaches into traditional primatology studies can yield a more comprehensive understanding of primate ecology and behavior, especially in regions where human-primate interactions are prevalent. This integration can further contribute to conservation efforts to protect primates and their habitats.

Moreover, recognizing the importance of Orang Asli knowledge can enhance wildlife conservation and management in Malaysia, particularly for primates. Such an approach can result in more holistic and culturally sensitive conservation strategies. By incorporating an ethnoprimatological perspective and participation of local people in conservation programs, existing policies and future action plans can be refined to increase the effectiveness and sustainability of successful primate conservation efforts.

4.2 | Validation of *Presbytis femoralis* distribution based on phylogenetic analysis and gene flow

Validation on the new distribution of *P. femoralis* in both Tasik Chini and Tasek Bera through genetic analysis seconded the ethnoprimatology approach as applied in the study. Based on different models, significant values of bootstraps and posterior probability of phylogenetic trees ensured that the collected fecal samples from the sites belong to the targeted species. Application of phylogenetic analysis is helpful especially when determining how and when these populations diverged from each other (Avise, 2000; Hey, 2010; Jones et al., 2018) or how closely related the examined populations are (Abdul-Latiff, Baharuddin, et al., 2019; Knowles & Richards, 2005; Liedtke et al., 2018; Turchetto-Zolet et al., 2020). The phylogeny trees constructed in this study indicated that populations found in Tasik Chini and Tasek Bera diverged and formed a separate clade compared to the original populations in Kota Tinggi and Mersing as Abdul-Latiff, Baharuddin, et al. (2019) mentioned, with estimated time of divergence between examined populations is between 2.91 and 4.07 Ma. Even though the probability value is high, the sequence coverage retrieved from all the examined populations was very low. Further analysis is required to properly resolve the evolutionary history of *P. femoralis* populations in Tasik Chini and Tasek Bera. According to Osada (2015), genetic diversity among closely related primate species is low and can lead to taxonomic instability. Nevertheless, understanding primate populations, especially the *genus Presbytis*, in both present and historic contexts through a genetic approach is crucial, as it can help resolve taxonomic discrepancies using high-throughput DNA sequencing. (Vigilant & Guschanski, 2009).

Gene flow, or migration, refers to the movement of alleles among spatially or temporally separated populations and is *a major* driving force in the evolution of populations. Gene flow may increase the genetic variation of populations but decrease the genetic difference between populations, which can slow or limit population differentiation (Endler, 1973; Fitzpatrick & Reid, 2019). Analysis on the gene flow and differentiation among all examined *P. femoralis* populations showed that the populations in southern part of Peninsular Malaysia serve as a plausible ancestral and from which other recorded populations may have derived. The individuals from southern Malaysia might migrate upward through the known localities within Johor region through Gunung Panti, Gunung Belumut, and Endau-Rompin National Park before establishing viable populations in Tasik Chini and Tasek Bera. Such an argument was supported with having Mersing and Kota Tinggi with the highest number of migrants per generation. However, to clearly resolve the population structure of *P. femoralis* in Tasek Bera and Tasik Chini further analysis with sequences of higher depth coverage should be conducted.

4.3 | New distributional records of *Presbytis femoralis*

Our study primarily observed the critically endangered banded langur near the forest edges of fragmented forest reserves, human-modified landscapes, peat swamps and plantations. These findings validate that the distribution of *P. femoralis* is much larger than reported in previous studies. This species occurs not only in the Endau-Rompin National Park, Gunung Panti, Gunung Lambak, Mersing, and Kota Tinggi, as mentioned by Md-Zain (2001), Abdul-Latiff, Baharuddin, et al. (2019), and Najmuddin, Haris, Othman, et al. (2020), Najmuddin, Haris, Norazlimi, et al. (2020) but it is also widely spread across fragmented forested areas in Johor. Additionally, in Pahang, our sightings complement the previous claim that the distribution of this species includes the southern part of the state, as reported by Brandon-Jones et al. (2004), Roos et al. (2014), Abdul-Latiff, Baharuddin, et al. (2019), and may even extend further north, including Taman Negara Pahang and along the Kuantan River, as indicated by the survey conducted by PERHILITAN staff (Figure 7). However, the northern and north-eastern limits of this species' potential range are still unclear.

It is also plausible that the species does not occur at higher altitudes and is restricted to foothill areas. During our observations, we did not find any signs of the species in very humid and cold surroundings, and the highest elevation at which we sighted the species was 450 m. Furthermore, we found that throughout the southern range of banded langurs, the species coexists with the long-tailed macaque (*Macaca fascicularis*) and dusky leaf monkey (*T. obscurus*) (Najmuddin, Haris, Norazlimi, et al., 2019; Najmuddin, Haris, Shahrool-Anuar, et al., 2019; Najmuddin, Haris, Othman, et al., 2020; Najmuddin, Haris, Norazlimi, et al., 2020). During our surveys, these three species were often observed in close proximity to one another, likely due to overlapping ranging areas within the small forest patches they inhabit. This association has also been reported by Najmuddin, Haris, Norazlimi, et al. (2019), Najmuddin, Haris, Shahrool-Anuar,

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

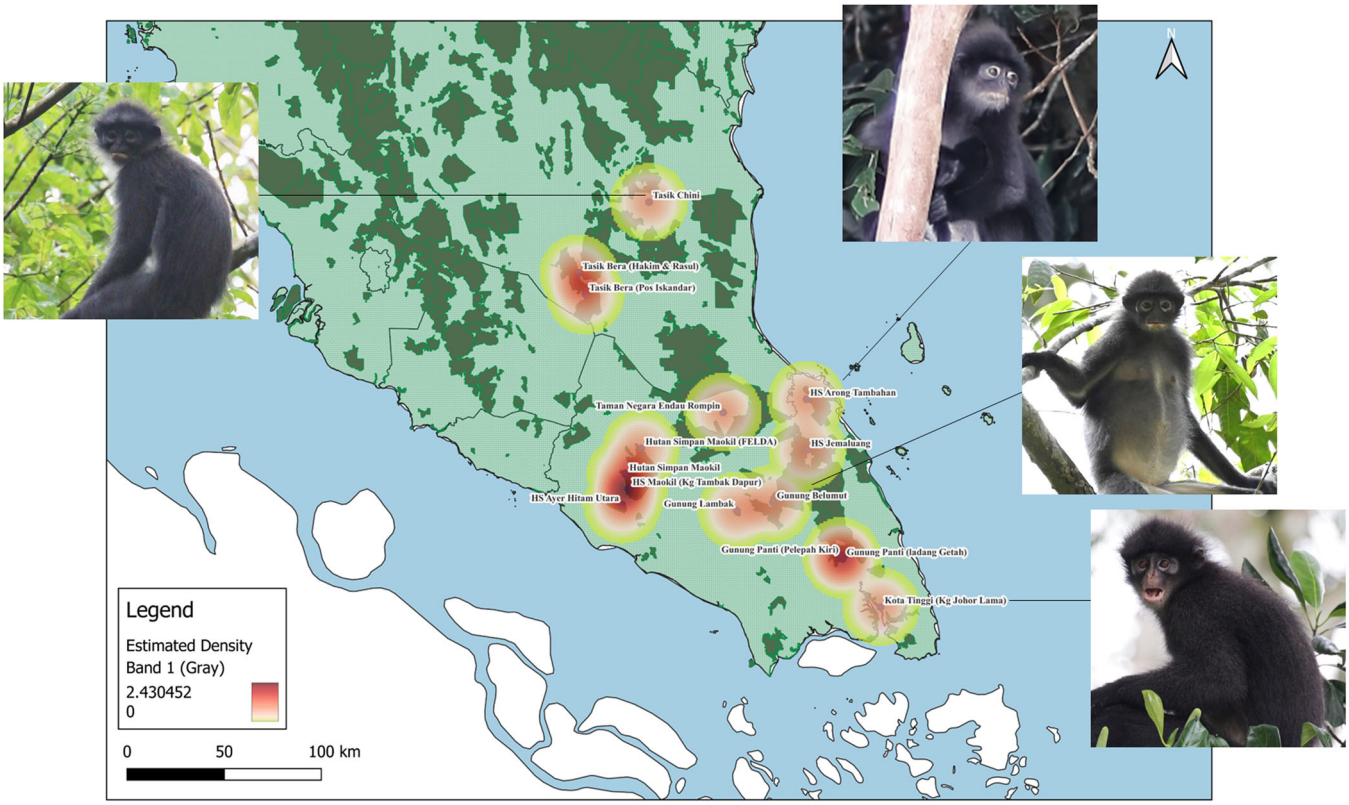

FIGURE 7 Map of species (*Presbytis femoralis*) occurrence and potential extended distribution in Malaysia.

et al. (2019), Najmuddin, Haris, Othman, et al. (2020), and Najmuddin, Haris, Norazlimi, et al. (2020).

During our study, we observed that the range of *P. femoralis* overlaps not only with other primate species but also with most Orang Asli villages, as well as rubber or oil palm plantations. We found that encounters with *P. femoralis* occurred within the roaming areas of the Orang Asli communities in Tasik Chini and Tasek Bera in Pahang, suggesting the potential for expanding the search for *P. femoralis* in other Orang Asli roaming areas. It is known that the Orang Asli utilize primate species, including *P. femoralis*, *T. obscurus*, and *P. siamensis*, as a source of protein (Najmuddin, Afiqah, et al., 2021; Zahari et al., 2021). Despite hunting activities, our study revealed that *P. femoralis* can commonly be found within Orang Asli villages and rubber and oil palm plantations. The presence of *P. femoralis* in these habitats can be attributed to their adaptive diet, which includes cultivated plants (Najmuddin, Haris, et al., 2021). In Johor Lama and Kota Tinggi Johor, the top five plant species selected by the banded langur included rubber tree (*Hevea brasiliensis*), rambutan (*Nephelium* sp.), banana (*Musa* sp.), and jackfruit (*Artocarpus* sp.), all of which are cultivated plants. The palm oil tree (*Elaeis* sp.) was also identified as a fallback food source for *P. femoralis* (Najmuddin, Haris, Shahrool-Anuar, et al., 2019; Najmuddin, Haris, et al., 2021). Orang Asli communities that have transitioned from a traditional hunter-gatherer lifestyle have adapted to small plantations and fruit orchards to sustain their food supply (Abdul-Latiff et al., 2021) These cultivated plant species may attract *P. femoralis* and other primates to range within Orang Asli villages in search for food supply.

Overall, this study emphasized that ethnoprimatology was very useful in revealing the current distribution of *P. femoralis* in Malaysia since this method helps understand the human and nonhuman primate integration in ecology and social space sharing (Fuentes et al., 2016). However, throughout the study, there were some limitations faced when ethnoprimatological survey was conducted including the language barrier (especially in identifying the *P. femoralis* through local name), confusion among respondents in recognizing the morphology of this species through photos provided and determining the reliability of data gathered based on the respondents' background and experience. Thus, a few recommendations are proposed for future study to collect comprehensive distribution data of primates in Malaysia. Ethnographic data should be combined with ethnoprimatological survey to ensure the right species is being reported. This is because the additional information of ethnographic data such as perception and behavioral response towards the primate described aid in identifying the species better, which overcomes the language and knowledge barrier limitations among respondents. For instance, *M. fascicularis* is well known for having antagonistic behaviors when encountering humans, making it easier to identify (Balasubramanian et al., 2020). Besides, the distribution of primates can be detected by exploring the places where people value primates according to their beliefs, myths, and folklore. Since the ranging habitat for *P. femoralis* is likely to be found

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

near Orang Asli settlement and plantation area, the area should be the focus for exploration and engagement for *P. femoralis* conservation efforts. Those highlighted areas consisting of multiple geographic features can be investigated further to get insight into the connectivity of *P. femoralis* habitat.

Since this study can only estimate the range of the species based on given locations, Geographical Information System (GIS) analysis cannot be done without other geographic data such as water bodies, land use, vegetation, elevation, topographic, and roads. The mystery of the distribution and migration of *P. femoralis* between fragmented habitats remains a challenge and is contingent on geographic data. A key recommendation for future research is the integration of geographic information system data with other methods of detection such as camera traps and bioacoustics. According to Howells et al. (2022), one of the tourist attractions in Indonesia known as Ubud Monkey Forest (sacred place for Hindu devotees) acts as a core habitat for primates, where the religious significance of the site facilitated the identification of five coexisting primate species in this area. In future ethnoprimatological studies, this approach may also be applied to update and revise information related to the primate population. Other than that, data on the population and distribution of this species can be used to update the list of plant species based on their dietary behavior data and create a conducive healthy ecosystem that may act as a better habitat for other wildlife. Finally, long-term monitoring of the population is vital for comprehending its general well-being and sustainability, as well as its responses to competition with other species and environmental changes. The findings can deepen our understanding of the primate species in Malaysia and ensure the long-term survival of the endangered primates from extinction.

5 | CONCLUSION

In conclusion, *P. femoralis* distribution has been significantly updated in this study, proven to be occurring in fragmented forest reserves, human-modified landscapes, and plantations of Johor and Pahang. The species presence overlaps with other primate species and more importantly Orang Asli villages, indicating the potential for expanding research and conservation efforts. The use of an ethnoprimatological approach, complemented by genetic analysis, has provided valuable insights into the distribution, population structure, and potential range of *P. femoralis* in Peninsular Malaysia. The study highlights the involvement of indigenous and local communities in primate research and conservation is crucial, as their knowledge and experiences contribute significantly to understanding primate behavior and ecology.

AUTHOR CONTRIBUTIONS

Hidayah Haris: Data curation (lead); Formal analysis (equal); Investigation (lead); Methodology (lead); Project administration (lead); Resources (equal); Software (equal); Visualization (lead); Writing—original draft (lead); Writing—review and editing (lead). **Nursyuhada Othman**: Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Software (equal); Writing—original draft (equal); Writing—review and editing (equal). **Munian Kaviarasu**: Data curation (equal); Formal analysis (equal); Investigation (equal); Methodology (equal); Software (equal); Supervision (supporting); Visualization (equal); Writing—original draft (equal); Writing—review and editing (equal). **Muhammad Faudzir Najmuddin**: Data curation (equal); formal analysis (equal); investigation (equal); methodology (equal); software (equal); visualization (equal); writing—original draft (equal); writing—review and editing (equal). **Nurfatiha Akmal Fawwazah Abdullah-Fauzi**: Data curation (equal); formal analysis (equal); investigation (equal); methodology (equal); writing—original draft (equal); writing—review and editing (equal). **Farah Farhana Ramli**: Formal analysis (equal); investigation (equal); methodology (equal); writing—original draft (equal); writing—review and editing (equal). **Nur Hartini Sariyati**: Formal analysis (equal); investigation (equal); methodology (equal); writing—original draft (equal); writing—review and editing (equal). **Mohd Lokman Ilham-Norhakim**: Investigation (equal); methodology (equal); resources (equal). **Badrul Munir Md-Zain**: Conceptualization (supporting); supervision (supporting); validation (equal). **Muhammad Abu Bakar Abdul-Latiff**: ConCeptualization (Lead); Data Curation (Lead); Formal Analysis (Equal); Funding Acquisition (Lead); Investigation (Equal); Project Administration (Lead); Supervision (Lead); Validation (lead).

ACKNOWLEDGMENTS

This project is funded by the Ministry of Higher Education Malaysia (MOHE) under the Fundamental Research Grant Scheme (FRGS) FRGS/1/2022/WAB11/UTHM/02/2-(UTHM-K416) and Research Enhancement-Graduate Grant (RE-GG-Q065) by Universiti Tun Hussein Onn Malaysia (UTHM). We are grateful and deeply indebted to YBhg. Dato' Abdul Kadir bin Abu Hashim, Director General of the Department of Wildlife and National Parks (DWNP), YBhg. Datuk Hjh Sapiah binti Dato' Mohd Nor, Director General of the Department of Orang Asli Development (JAKOA) and YBhg Tuan Mohd Zikri Bin Omar, Deputy Secretariat for Pahang Biodiversity Council for granting permission to carry out this research and provided us with the necessary facilities and assistance. We acknowledge the contributions of Academy of Sciences Malaysia (ASM) in this research through ASM Tasik Chini Task Force. We also acknowledge Pn Hani Nabilia Binti Muhd Sahimi and En Rosedan bin Mat Ami from DWNP that provided us with valuable insights about *P. femoralis*. Authors acknowledge the Ministry of Higher Education Malaysia (MOHE) and Universiti Tun Hussein Onn Malaysia (UTHM) for providing necessary funding, facilities and assistance.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare absence of conflicting interests with the funders.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

ORCID

Muhammad Abu Bakar Abdul-Latiff http://orcid.org/0000-0001-9551-8571

REFERENCES

Abdul-Latiff, M. A. B., Afiqah, M. A., Zahari, F., Othman, N., Haris, H., Najmuddin, M. F., & Md-Zain, B. M. (2021). The ethnozoology, wildlife utilisation and hunting practices of the Semoq Beri Tribe in Pahang, *Resource Use and Sustainability of Orang Asli: Indigenous Communities in Peninsular Malaysia* (pp. 109–136). Springer. https://doi.org/10.1007/978-3-030-64961-6_9

Abdul-Latiff, M. A. B., Aifat, N. R., Yaakop, S., & Md-Zain, B. M. (2017). A non-invasive molecular approach: Exploiting species-locus-specific PCR primers in defeating numts and DNA cross-contamination of cercopithecidae. *Journal of Animal & Plant Sciences*, *27*(3), 1015–1023.

Abdul-Latiff, M. A. B., Baharuddin, H., Abdul-Patah, P., & Md-Zain, B. M. (2019). Is Malaysia's banded langur, *Presbytis femoralis femoralis*, actually *Presbytis neglectus neglectus*? Taxonomic revision with new insights on the radiation history of the *Presbytis* species group in Southeast Asia. *Primates*, *60*(1), 63–79. https://doi.org/10.1007/s10329-018-0699-y

Abdul-Latiff, M. A. B., Najmuddin, M. F., Haneef, S. K., Nabil, A., Shahrool-Anuar, R., & Md-Zain, B. M. (2019). Transforming ranging behaviour of Schlegel's Banded Langur (*Presbytis neglectus*) into PrimaTourism product, In *IOP Conference Series: Earth and Environmental Science* (Vol. 269, p. 012005). IOP Publishing. No. 1. https://doi.org/10.1088/1755-1315/269/1/012005

Abdul-Latiff, M. A. B., Ruslin, F., Faiq, H., Hairul, M. S., Rovie-Ryan, J. J., Abdul-Patah, P., Yaakop, S., & Md-Zain, B. M. (2014). Continental monophyly and molecular divergence of peninsular Malaysia's *Macaca fascicularis fascicularis*. *BioMed Research International*, *2014*, 1–18. https://doi.org/10.1155/2014/897682

Aifat, N. R., Yaakop, S., & Md-Zain, B. M. (2016). Optimization of partial cyt b gene sequence from selected ancient presbytis museum skin specimens. *Malaysian Applied Biology*, *45*(1), 93–96.

Aimi, M., & Bakar, A. (1996). Distribution and deployment of *Presbytis melalophos* group in sumatera, Indonesia. *Primates*, *37*, 399–409. https://doi.org/10.1007/BF02381375

Ang, A., Roesma, D. I., Nijman, V., Meier, R., Srivathsan, A., & Rizaldi, A. (2020). Faecal DNA to the rescue: Shotgun sequencing of non-invasive samples reveals two subspecies of Southeast Asian primates to be critically endangered species. *Scientific Reports*, *10*(1), 9396. https://doi.org/10.1038/s41598-020-66007-8

Avise, J. C. (2000). *Phylogeography: The history and formation of species*. Harvard University Press. https://doi.org/10.2307/j.ctv1nzfgj7

Balasubramaniam, K. N., Sueur, C., Huffman, M. A., & MacIntosh, A. J. (2020). Primate infectious disease ecology: Insights and future directions at the human-macaque interface, *The behavioral ecology of the Tibetan macaque* (pp. 249–284). Springer.

Bandelt, H. J., Forster, P., & Rohl, A. (1999). Median-joining networks for inferring intraspecific phylogenies. *Molecular Biology and Evolution*, *16*(1), 37–48. https://doi.org/10.1093/oxfordjournals.molbev.a026036

Bartholomew, C. V., Zainir, M. I., Nor Zalipah, M., Husin, M. H., & Abdullah, M. T. (2021). Wildlife hunting practices by the indigenous people of Terengganu, Peninsular Malaysia. In M. T. Abdullah, C. V. Bartholomew, & A. Mohammad (Eds.), *Resource use and sustainability of Orang Asli: Indigenous communities in Peninsular Malaysia* (pp. 137–153). Springer. https://doi.org/10.1007/978-3-030-64961-6_10

Bersacola, E., Hill, C. M., Nijman, V., & Hockings, K. J. (2022). Examining primate community occurrence patterns in agroforest landscapes using arboreal and terrestrial camera traps. *Landscape Ecology*, *37*(12), 3103–3121. https://doi.org/10.1007/s10980-022-01524-7

Brandon-Jones, D., Eudey, A. A., Geissmann, T., Groves, C. P., Melnick, D. J., Morales, J. C., Shekelle, M., & Stewart, C. B. (2004). Asian primate classification. *International Journal of Primatology*, *25*(1), 97–164. https://doi.org/10.1023/B:IJOP.0000014647.18720.32

Endler, J. A. (1973). Gene flow and population differentiation. *Science*, *179*(4070), 243–250. https://doi.org/10.1126/science.179.4070.243

Fitzpatrick, S. W., & Reid, B. N. (2019). Does gene flow aggravate or alleviate maladaptation to environmental stress in small populations? *Evolutionary Applications*, *12*(7), 1402–1416. https://doi.org/10.1111/eva.12768

Fix, A. G. (2000). Genes, language, and ethnic groups: Reconstructing orang asli prehistory, Indo-Pacific prehistory. the melaka papers. *Bulletin of the Indo-Pacific Prehistory Association*, *19*, 11–16.

Fuentes, A. (2006). Human-Nonhuman primate interconnections and their relevance to anthropology. *Ecological and Environmental Anthropology*, *2*, 1–11.

Fuentes, A. (2012). Ethnoprimatology and the anthropology of the Human-Primate interface. *Annual Review of Anthropology*, *41*, 101–117. https://doi.org/10.1146/annurev-anthro-092611-145808

Fuentes, A., Cortez, A. D., & Peterson, J. V. (2016). Ethnoprimatology and conservation: Applying insights and developing practice. In M. T. Waller (Ed.), *Ethnoprimatology: Primate conservation in the 21st century* (pp. 1–19). Springer. https://doi.org/10.1007/978-3-319-30469-4_1

Fuentes, A., & Hockings, K. J. (2010). The ethnoprimatological approach in primatology. *American Journal of Primatology*, *72*(10), 841–847. https://doi.org/10.1002/ajp.20844

Green, V. M., & Gabriel, K. I. (2020). Researchers' ethical concerns regarding habituating Wild-Nonhuman primates and perceived ethical duties to their subjects: Results of an online survey. *American Journal of Primatology*, *82*(9), e23178. https://doi.org/10.1002/ajp.23178

Groves, C. P. (2001). *Primate taxonomy* (p. 350). Smithsonian Institution Press. https://doi.org/10.1002/9781118584538.ieba0405

Haris, N. (2021). DNA Metabarcoding and Phytochemical Analysis of Plants Consumed by Banded Langur (Presbytis femoralis) in Johor (Doctoral dissertation, Universiti Tun Hussein Malaysia).

Hey, J. (2010). Isolation with migration models for more than two populations. *Molecular Biology and Evolution*, *27*(4), 905–920. https://doi.org/10.1093/molbev/msp296

van der Hoeven, C. A., de Boer, W. F., & Prins, H. H. T. (2004). Pooling local expert opinions for estimating mammal densities in tropical rainforests. *Journal For Nature Conservation*, *12*(4), 193–204. https://doi.org/10.1016/j.jnc.2004.06.003

Howells, M. E., Loudon, J. E., Brotcorne, F., Petterson, J. V., Wandia, I. N., Putra, I. A., & Fuentes, A. (2022). Primates and primatologists: Reflecting on two decades of primatological and ethnoprimatological research, tourism, and conservation at the Ubud Monkey Forest, *Ecotourism and Indonesia's primates* (pp. 153–178). Springer International Publishing. https://doi.org/10.1007/978-3-031-14919-1_8

Hsu, M. J., Kao, C. C., & Agoramoorthy, G. (2009). Interactions between visitors and formosan macaques (*Macaca cyclopis*) at Shou-Shan nature park, Taiwan. *American Journal of Primatology*, *71*(3), 214–222. https://doi.org/10.1002/ajp.20638

Jabatan Kemajuan Orang Asli (JAKOA). (2020). Suku Kaum Orang Asli Semenanjung Malaysia. Retrieved from https://www.jakoa.gov.my/

Knowles, L. L., & Richards, C. L. (2005). Importance of genetic drift during pleistocene divergence as revealed by analyses of genomic variation. *Molecular Ecology*, *14*(13), 4023–4032. https://doi.org/10.1111/j.1365-294X.2005.02727.x

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Kumar, S., Stecher, G., Li, M., Knyaz, C., & Tamura, K. (2018). MEGA X: Molecular evolutionary genetics analysis across computing platforms *Molecular Biology and Evolution*, *35*(6), 1547–1549. https://doi.org/10.1093/molbev/msy096

Lee, P. C. (2010). Sharing space: Can ethnoprimatology contribute to the survival of non-human primates in human-dominated globalized landscapes? *American Journal of Primatology*, *72*(10), 925–931. https://doi.org/10.1002/ajp.20789

Lye, T. (2021). Tracking with batek hunter-gatherers of Malaysia. In A. Pastoors & T. Lenssen-Erz (Eds.), *Reading prehistoric human tracks: Methods & material* (pp. 345–362). Springer Nature. https://doi.org/10.1007/978-3-030-60406-6_18

Malone, N., Wade, A. H., Fuentes, A., Riley, E. P., Remis, M., & Robinson, C. J. (2014). Ethnoprimatology: Critical interdisciplinarity and multispecies approaches in anthropology. *Critique of Anthropology*, *34*(1), 8–29. https://doi.org/10.1177/0308275X13510188

Mayaka, T. B., Takoukam Kamla, A., & Self-Sullivan, C. (2015). Using pooled local expert opinions (PLEO) to discern patterns in sightings of live and dead manatees (*Trichechus senegalensis*, Link 1785) in lower sanaga basin, Cameroon. *PLoS One*, *10*(7), e0128579. https://doi.org/10.1371/journal.pone.0128579

Md-Zain, B. M. (2001). *Molecular systematics of the genus Presbytis*. Columbia University, Ph.D. thesis.

Md-Zain, B. M. (2004). Primat Taman Negeri Endau Rompin. In S. M. Ismail, Mokhtar Mat Isa, W. Yusoff W. Ahamd, M. Rahim Ramli & A. Latiff (Eds.), *Taman Negeri Endau Rompin: Pengurusan, Persekitaran Fizikal dan Biologi* (pp. 231–236). Siri Kepelbagaian Biologi Hutan, Jabatan Perhutanan Semenanjung Malaysia.

Md-Zain, B. M., Abdul-Manan, M. N., Abdul-Latiff, M. A. B., Mohd-Daut, N., & Rahman, A. (2019). Positional behavior of Robinson's banded langur (*Presbytis femoralis robinsoni*). *Journal of Sustainability Science and Management*, *14*(5), 164–174.

Md-Zain, B. M., & Ch'ng, C. E. (2010). The activity patterns of a group of Cantor' dusky leaf monkeys (*Trachypithecus obscurus* halonifer). *International Journal of Zoological Research*, *7*(1), 59–67. https://doi.org/10.3923/ijzr.2011.59.67

Md-Zain, B. M., Mohamad, M., Ernie-Muneerah, M. A., Ampeng, A., Jasmi, A., Lakim, M., & Mahani, M. C. (2010). Phylogenetic relationships of Malaysian monkeys, Cercopithecidae, based on mitochondrial cytochrome c sequences. *Genetics and Molecular Research*, *9*(4), 1987–1996. https://doi.org/10.4238/vol9-4gmr942

Meijaard, E., Buchori, D., Hadiprakarsa, Y., Utami-Atmoko, S. S., Nurcahyo, A., Tjiu, A., Prasetyo, D., Nardiyono, D., Christie, L., Ancrenaz, M., Abadi, F., Antoni, I. N. G., Armayadi, D., Dinato, A., Ella, A., Gumelar, P., Indrawan, T. P., Kussaritano, C., Munajat, C., … Mengersen, K. (2011). Quantifying killing of orangutans and human-orangutan conflict in kalimantan, Indonesia. *PLoS One*, *6*(11), e27491. https://doi.org/10.1371/journal.pone.0027491

Mekonnen, A., Fashing, P. J., Bekele, A., & Stenseth, N. C. (2020). Use of cultivated foods and matrix habitat by Bale monkeys in forest fragments: Assessing local human attitudes and perceptions. *American Journal of Primatology*, *82*(4), e23074. https://doi.org/10.1002/ajp.23074

Meyer, D., Rinaldi, I. D., Ramlee, H., Perwitasari-Farajallah, D., Hodges, J. K., & Roos, C. (2011). Mitochondrial phylogeny of leaf monkeys (genus *Presbytis*, Eschscholtz, 1821) with implications for taxonomy and conservation. *Molecular Phylogenetics and Evolution*, *59*(2), 311–319. https://doi.org/10.1016/j.ympev.2011.02.015

Najmuddin, M. F., Afiqah, A., Fatin, Z., Othman, N., Haris, H., Md-Zain, B. M., & Bakar Abdul-Latiff, M. A. (2021). Ethnoprimatological survey among Semoq Beri (Senoi) in Maran, Pahang, Malaysia. *Malayan Nature Journal*, *73*(4), 641.

Najmuddin, M. F., Haris, H., Norazlimi, N., Md-Zain, B. M., Mohd-Ridwan, A. R., Shahrool-Anuar, R., & Abdul-Latiff, M. A. B. (2019). Predation of domestic dogs (*Canis lupus familiaris*) on Schlegel's banded langur (*Presbytis neglectus*) and crested hawk-eagle (*Nisaetus cirrhatus*) on dusky leaf monkey (*Trachypithecus obscurus*) in Malaysia. *Journal of Sustainability Science and Management*, *14*(6), 39–50.

Najmuddin, M. F., Haris, H., Norazlimi, N., Md-Zain, B. M., Mohd-Ridwan, A. R., Shahrool-Anuar, R., & Abdul-Latiff, M. A. B. (2020). Daily activity budget of banded langur (*Presbytis femoralis*) in Malaysia. *Journal of Sustainability Science and Management*, *15*(5), 84–97. https://doi.org/10.46754/jssm.2020.07.009

Najmuddin, M. F., Haris, H., Norazlimi, N., Ruslin, F., Matsuda, I., Md-Zain, B. M., & Abdul-Latiff, M. A. B. (2021). Dietary habits of free-ranging banded langur (*Presbytis femoralis*) in a secondary-human modified forest in Johor, Malaysia. *Zoological Studies*, *60*, e47. https://doi.org/10.6620/ZS.2021.60-67

Najmuddin, M. F., Haris, H., Othman, N., Zahari, F., Md-Zain, B. M., Shahrool-Anuar, R., & Abdul-Latiff, M. A. B. (2020). Data on first record of brown morph banded langur (*Presbytis femoralis*), leucistic dusky leaf monkey (*Trachypithecus obscurus*) in Malaysia and review of morph diversity in Langur (Colobinae). *Data in Brief*, *31*, 105727. https://doi.org/10.1016/j.dib.2020.105727

Najmuddin, M. F., Haris, H., Shahrool-Anuar, R., Norazlimi, N., Md-Zain, B. M., & Abdul-Latiff, M. A. B. (2019). PrimaTourism: Plant selection by Schlegel's Banded Langur *Presbytis neglectus* in Johor, *IOP Conference Series: Earth and Environmental Science* (Vol. 269, p. 012036). IOP Publishing. No. 1Singh. https://doi.org/10.1088/1755-1315/269/1/012036

Najmuddin, M. F., Haris, H., Sufahani, S. F., Abdullah, N. M., Md-Zain, B. M., Lokman, M. I. N., & Abdul-Latiff, M. A. B. (2023). Evaluation of wildlife distribution data in Southeast Asia: Public data mining and ecological modelling of Malaysia's primate. *Malayan Nature Journal*, *75*(2), 321–339.

Oates, J. F. & Davies, A. G., (Eds.). (1994). *Colobine monkeys: Their ecology, behaviour, and evolution*. Cambridge University Press.

Osada, N. (2015). Genetic diversity in humans and non-human primates and its evolutionary consequences. *Genes & Genetic Systems*, *90*, 133–145. https://doi.org/10.1266/ggs.90.133

Parathian, H. E., & Maldonado, A. M. (2010). Human–non-human primate interactions amongst Tikuna people: Perceptions and local initiatives for resource management in Amacayacu in the Colombian Amazon. *American Journal of Primatology*, *72*(10), 855–865. https://doi.org/10.1002/ajp.20816

Pérez i de Lanuza, G., Sillero, N., & Carretero, M. Á. (2018). Climate suggests environment-dependent selection on lizard colour morphs. *Journal of Biogeography*, *45*(12), 2791–2802. https://doi.org/10.1111/jbi.13455

QGIS Development Team. (2022). *QGIS geographic information system open source geospatial foundation*. http://qgis.osgeo.org

Rambaut, A. (2006). FigTree: Tree figure drawing tool, Version 1.3.1. Institute of Evolutionary Biology, University of Edinburgh. http://tree.bio.ed.ac.uk/software/figtree/.

Rambaut, A., & Drummond, A. (2005). Tracer v1.3: MCMC Trace Analysis Tool. Institute of Evolutionary Biology, University of Edinburgh. http://tree.bio.ed.ac.uk/software/tracer/.

Riley, E. P. (2007). The Human–Macaque interface: Conservation implications of current and future overlap and conflict in lore lindu national park, sulawesi, Indonesia. *American Anthropologist*, *109*(3), 473–484. https://doi.org/10.1525/aa.2007.109.3.473

Roos, C., Boonratana, R., Supriatna, J., Fellowes, J. R., Groves, C. P., Nash, S. D., & Mittermeier, R. A. (2014). An updated taxonomy and conservation status review of Asian primates. Asian Primates Journal. *4*, 2–38.

Ronquist, F., Huelsenbeck, J. P., & van der Mark, P. (2005). *MrBayes 3.1 manual*.

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Rozas, J., Ferrer-Mata, A., Sánchez-DelBarrio, J. C., Guirao-Rico, S., Librado, P., Ramos-Onsins, S. E., & Sánchez-Gracia, A. (2017). DnaSP 6: DNA sequence polymorphism analysis of large datasets. *Molecular Biology and Evolution*, *34*, 3299–3302. https://doi.org/10.1093/molbev/msx248

Rozas, J., Sánchez-DelBarrio, J. C., Messeguer, X., & Rozas, R. (2003). DnaSP, DNA polymorphism analyses by the coalescent and other methods. *Bioinformatics*, *19*(18), 2496–2497. https://doi.org/10.1093/bioinformatics/btg359

Shanee, S., Fernández-Hidalgo, L., Allgas, N., Vero, V., Bello-Santa Cruz, R., Bowler, M., Erkenswick Watsa, M., García Mendoza, G., García-Olaechea, A., Hurtado, C., Vega, Z., Marsh, L., Boonratana, R., & Mendoza, A. P. (2023). Threat analysis of forest fragmentation and degradation for Peruvian primates. *Diversity*, *15*(2), 276. https://doi.org/10.3390/d15020276

Sponsel, L. E. (1997). The human niche in Amazonia: Explorations in ethnoprimatology. In W. G. Kinzey (Ed.), *New world primates: Ecology, evolution, and behaviour* (pp. 143–165). Aldine de Gruyter.

Suchard, M. A., Lemey, P., Baele, G., Ayres, D. L., Drummond, A. J., & Rambaut, A. (2018). Bayesian phylogenetic and phylodynamic data integration using BEAST 1.10 Virus Evolution 4, vey016. https://doi.org/10.1093/ve/vey016

Trejo, L., Rosell, J. A., & Olson, M. E. (2018). Nearly 200 years of sustained selection have not overcome the leaf area–stem size relationship in the poinsettia. *Evolutionary Applications*, *11*(7), 1401–1411. https://doi.org/10.1111/eva.12634

Vigilant, L., & Guschanski, K. (2009). Using genetics to understand the dynamics of wild primate populations. *Primates*, *50*, 105–120. https://doi.org/10.1007/s10329-008-0124-z

Yang, B., Zhang, G., Guo, F., Wang, M., Wang, H., & Xiao, H. (2020). A genomewide scan for genetic structure and demographic history of two closely related species, *Rhododendron dauricum* and *R. mucronulatum* (Rhododendron, Ericaceae). *Frontiers in Plant Science*, *11*, 1093. https://doi.org/10.3389/fpls.2020.01093

Zahari, F. N. A., Othman, N., Haris, H., Faudzir, N. M., Md-Zain, B. M., & Abdul Latiff, M. A. B. (2021). Ethnoprimatological survey among Temuan (Proto-Malay) in Gunung Ledang, Johor, Malaysia. *Malayan Nature Journal*, *73*(4), 647–652.

How to cite this article: Haris, H., Othman, N., Kaviarasu, M., Najmuddin, M. F., Abdullah-Fauzi, N. A. F., Ramli, F. F., Sariyati, N. H., Ilham-Norhakim, M. L., Md-Zain, B. M., & Abdul-Latiff, M. A. B. (2024). Ethnoprimatology reveals new extended distribution of critically endangered banded langur *Presbytis femoralis* (Martin, 1838) in Pahang, Malaysia: Insights from indigenous traditional knowledge and molecular analysis. *American Journal of Primatology*, *86*, e23631. https://doi.org/10.1002/ajp.23631

10982345, 2024, 11, Downloaded from https://onlinelibrary.wiley.com/doi/10.1002/ajp.23631 by University Of Texas At San Antonio Libraries, Wiley Online Library on [11/06/2025]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License